Master the Challenge of Generating OpenDRIVE Road Networks based on Real World Data

8th OpenDRIVE User Meeting

15th October 2015, Stuttgart

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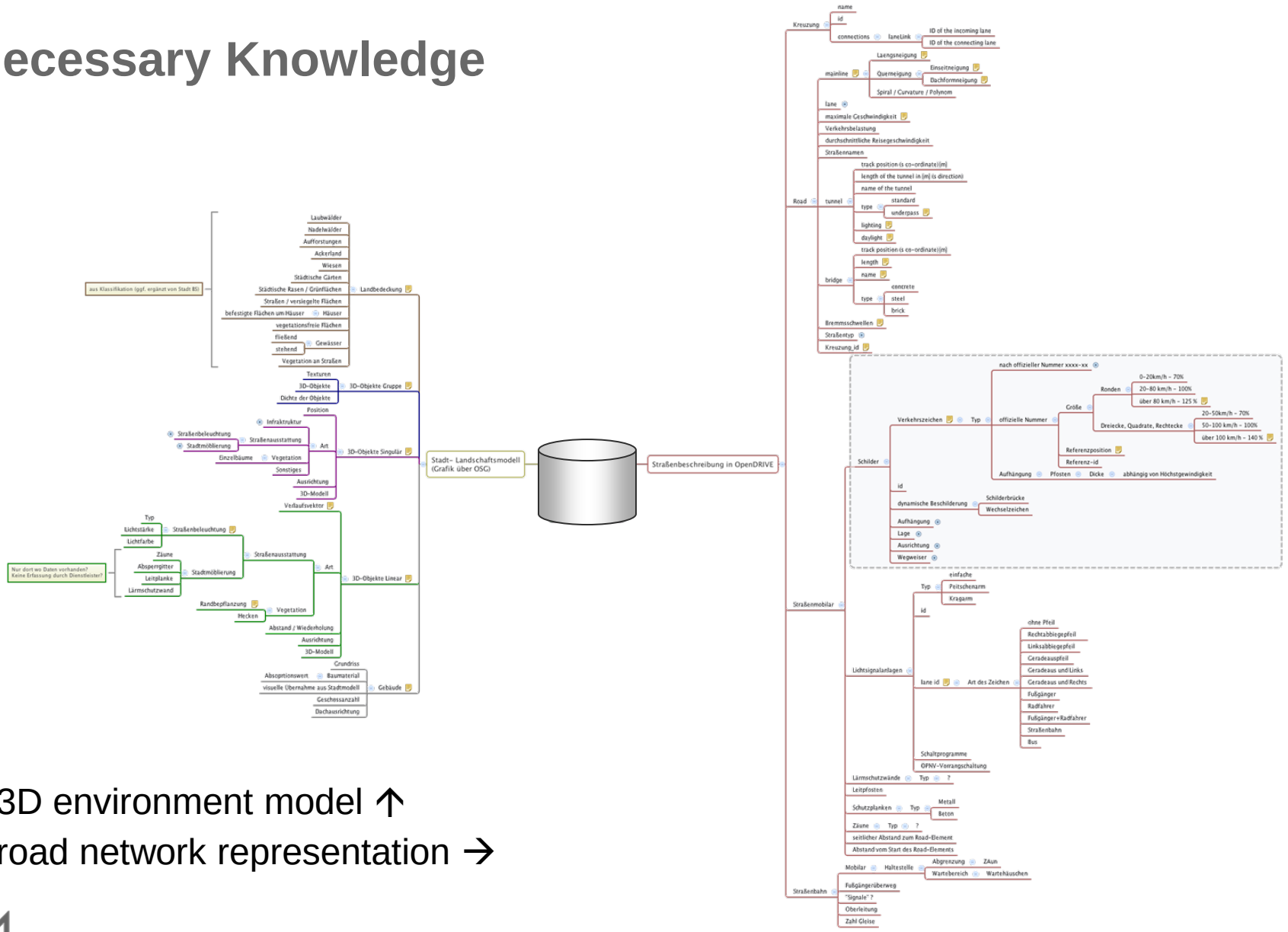
Recreation of Urban Areas in Driving Simulators
Used Systems

Recreation of Urban Areas in Driving Simulators
Complex Reality

Necessary Knowledge



- 3D environment model ↑
- road network representation →

Available Knowledge
Digital Spatial Data

- digital city models for noise and emission cadaster
- digital elevation models
- road topography
- infrastructure cadaster (street lighting, traffic lights, road signs and signposts, street furniture, etc.)
- meta data (material attributes, age, labels, etc.)

- borderless usage of spatial data with
  - INfrastructure for SPatial InfoRmation in Europe (INSPIRE)
  - to create a common European spatial data infrastructure

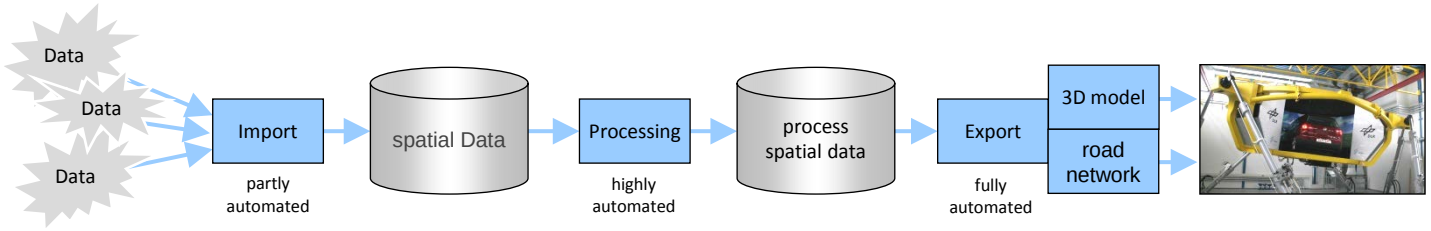
- crowd sourcing of spatial data (bicycle and hiking maps, points of interest, city models, etc.)

Project Virtual World

Approach

- Creation of a **Digital Atlas** that is able to describes multi modal metropolitan areas (including roads, rails, development, environment, infrastructure, etc.)
  - This Digital Atlas was filled with data about the test area of Braunschweig, Germany as virtual counterpart to DLR's Application Platform for Intelligent Mobility (**AIM**). The Digital Atlas will continue to grow…

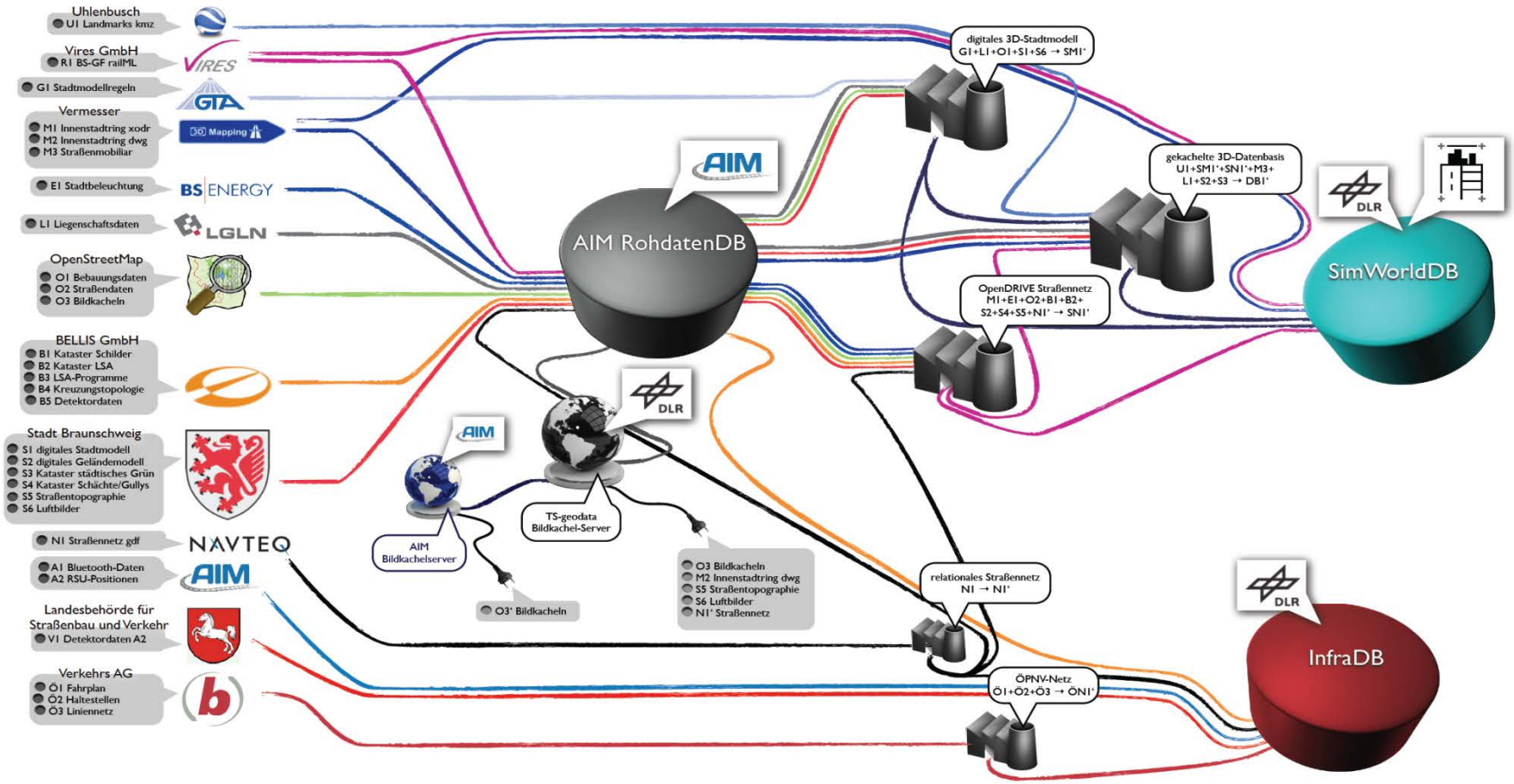
- Setup of a **Tool Chain**, that is able to generate virtual Worlds and logical descriptions for driving and traffic simulations as well as high precise maps for autonomous driving.



  - Full reuse of the Tool Chain with new data sources and new targets.

Project Virtual World

Used Spatial Data



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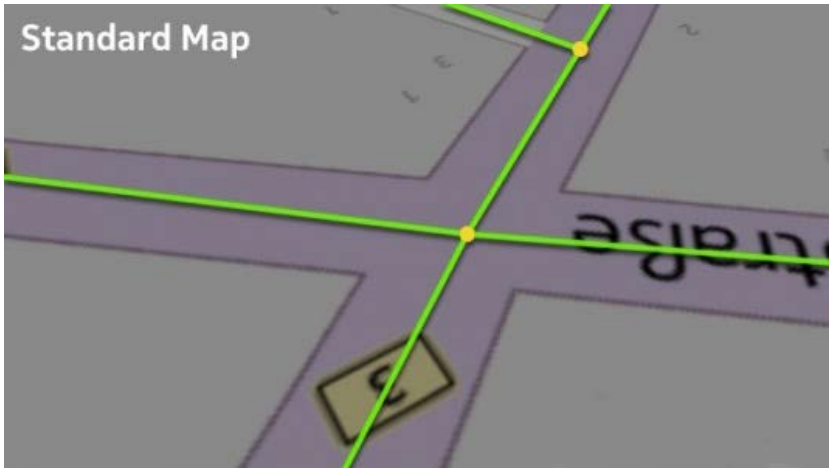
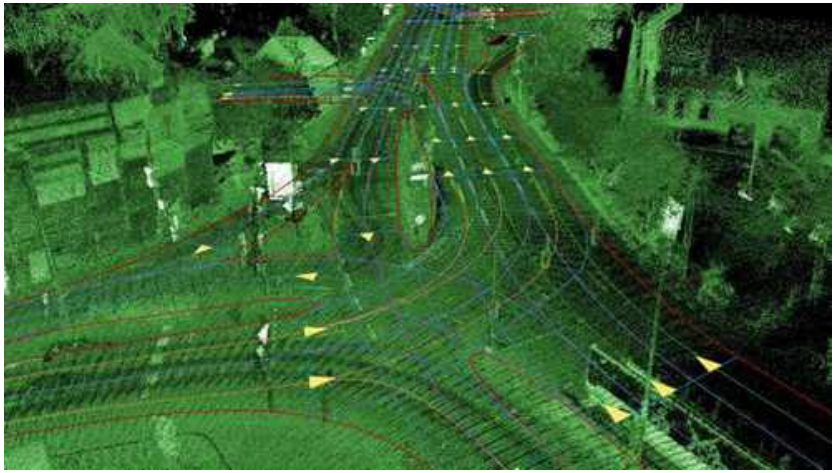
Road Network

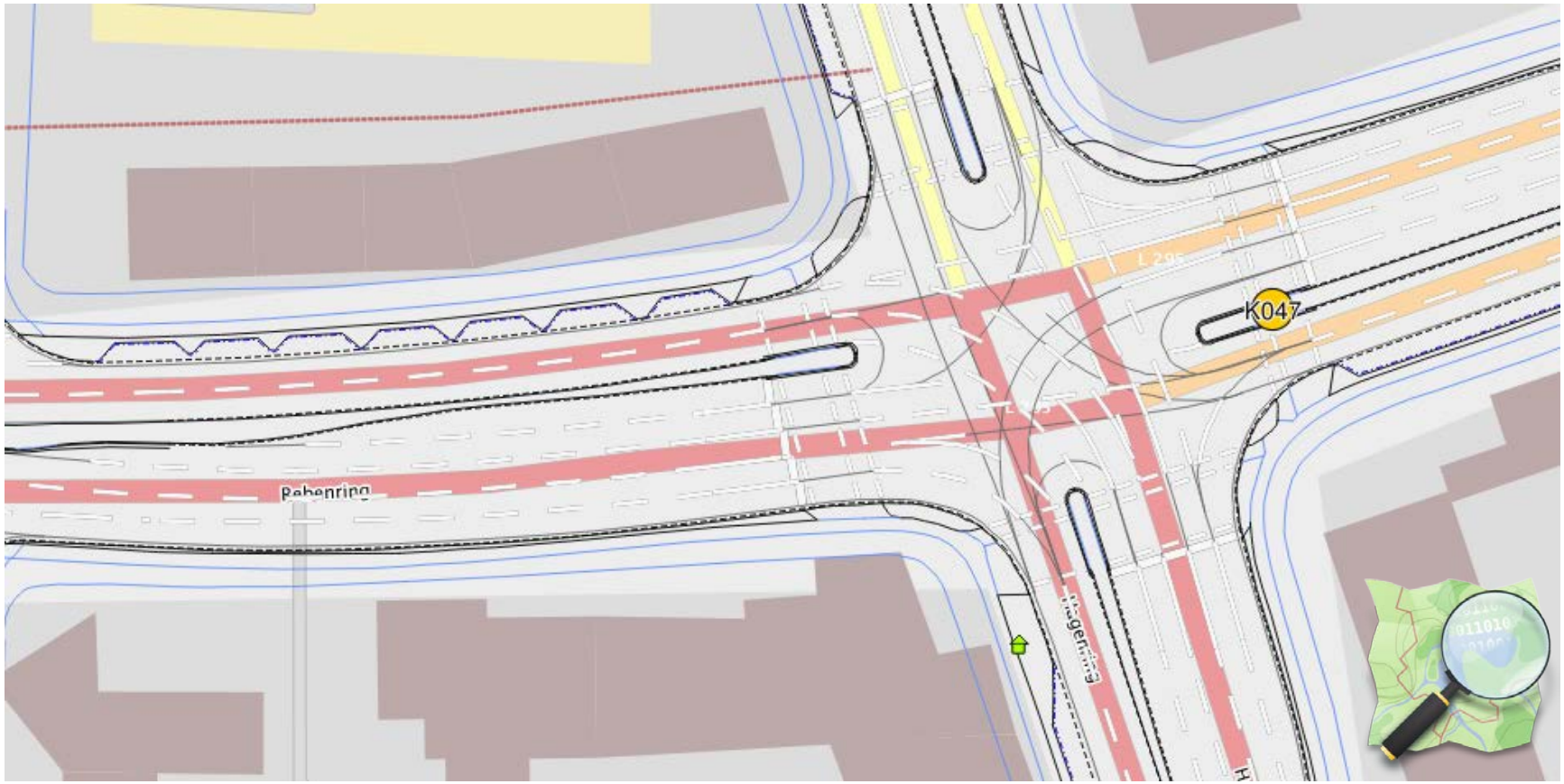
Available Knowledge
Commercial Road Network Data





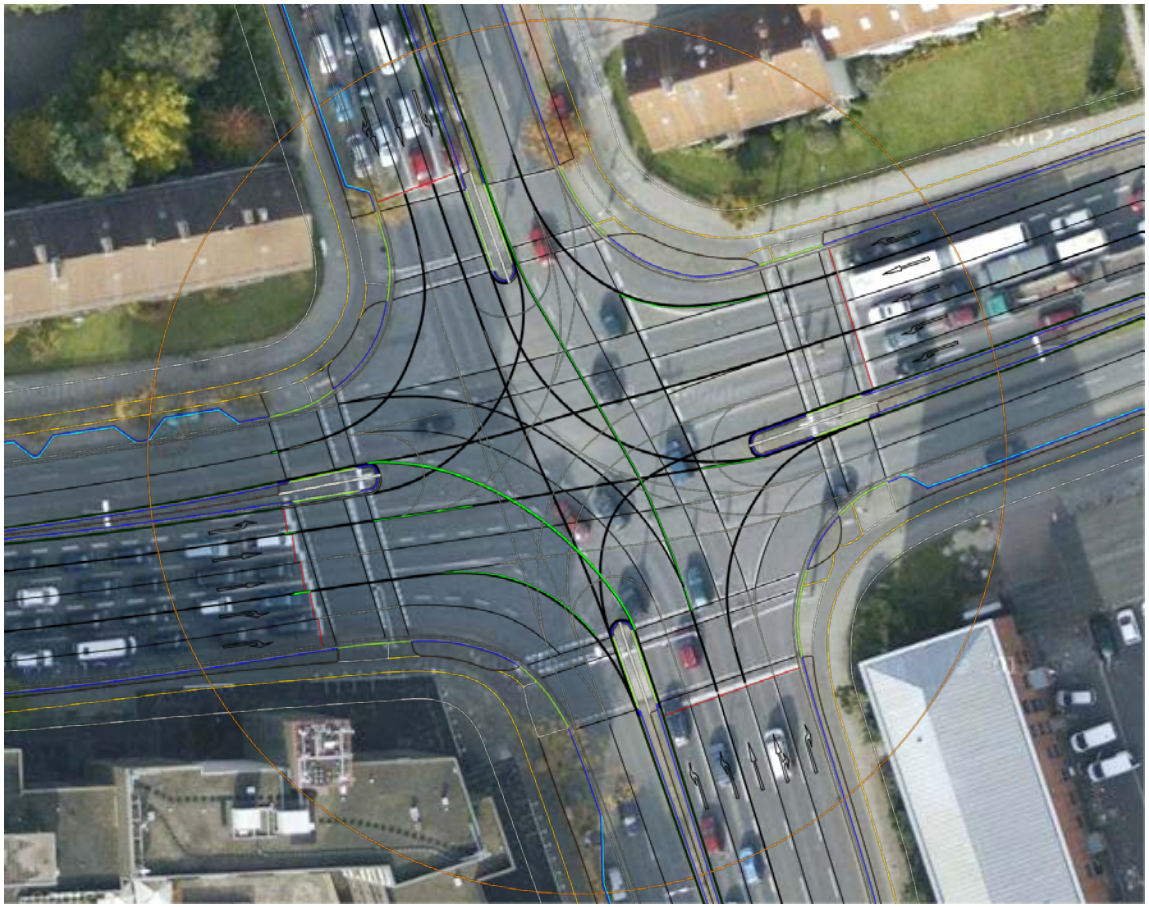
Available Knowledge
Free Road Network Data

- logic road network without topographic information (overlay by DLR)

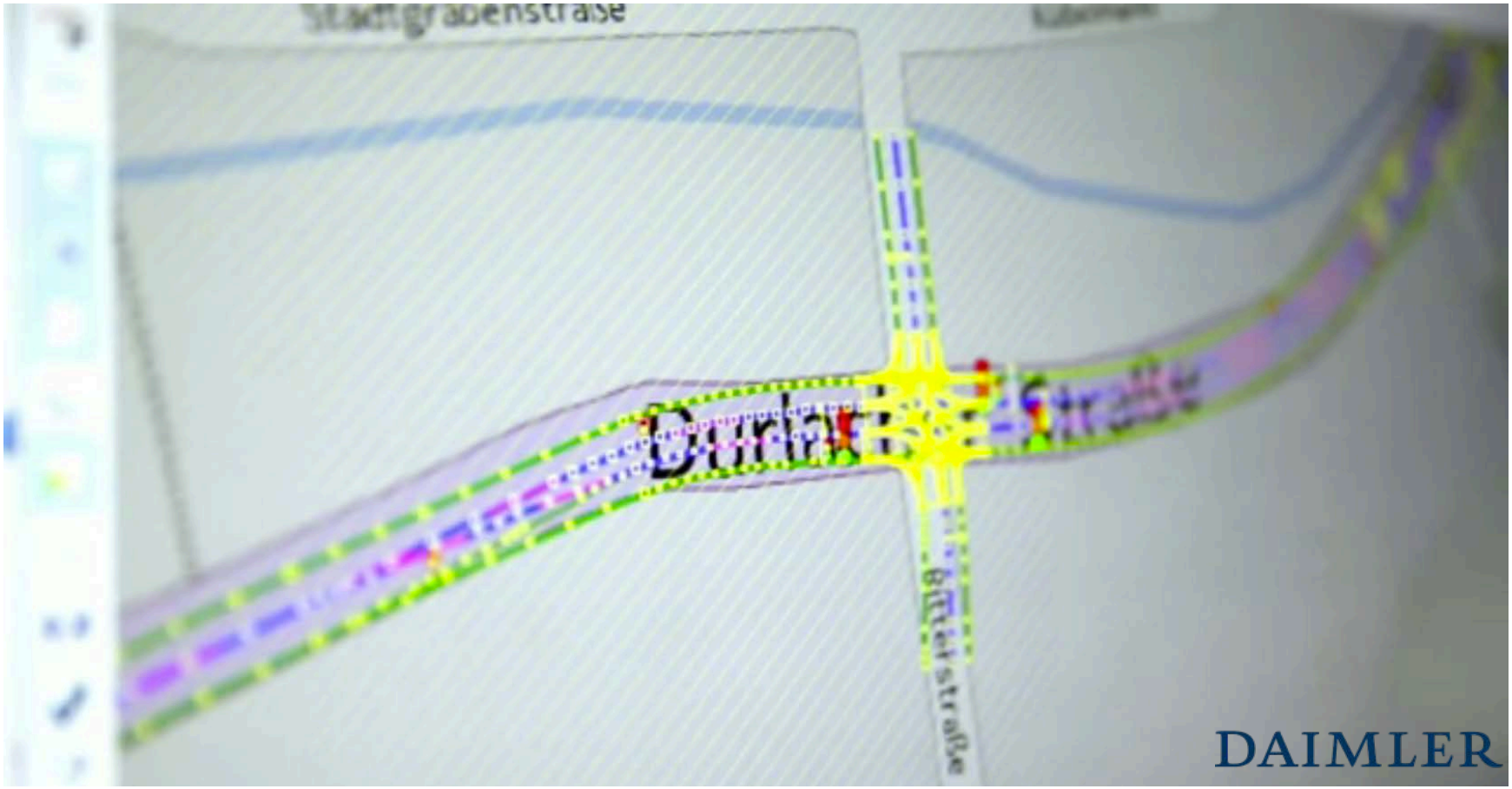


Generation of Road Networks
Surveying of the Original

- high precise surveying (Overlay)



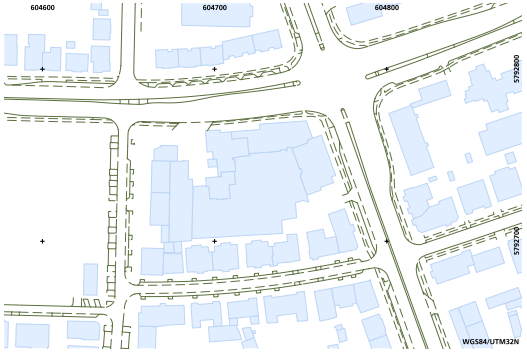
Generation of Road Networks
Surveying of the Original

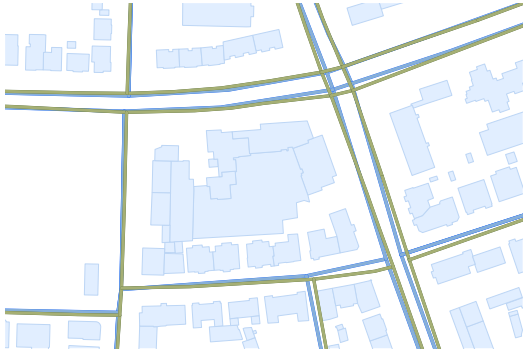


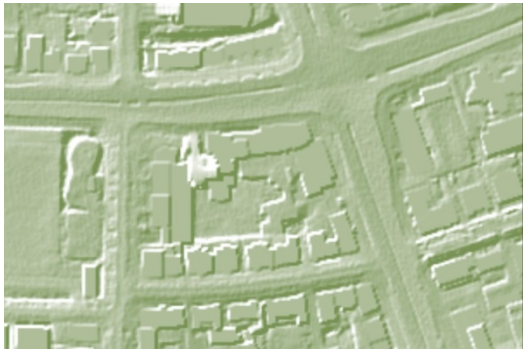
Generation of Road Networks

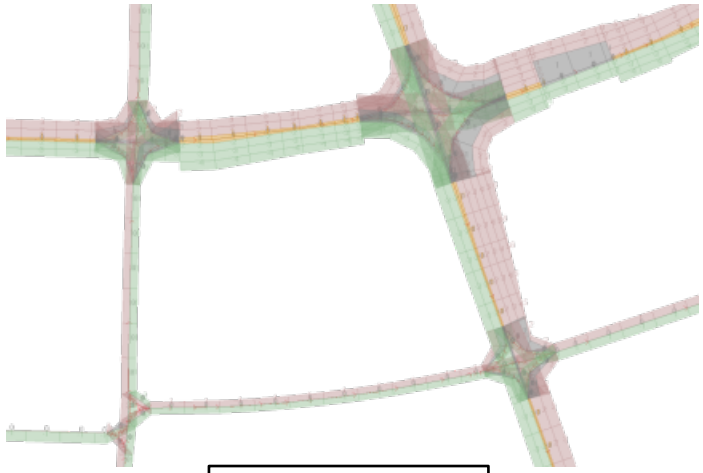
Generation based on Cadastral Data

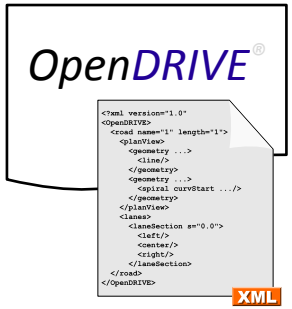
- combination of computer graphics GIS approach
  - Input: cadastral data
  - Output: OpenDRIVE







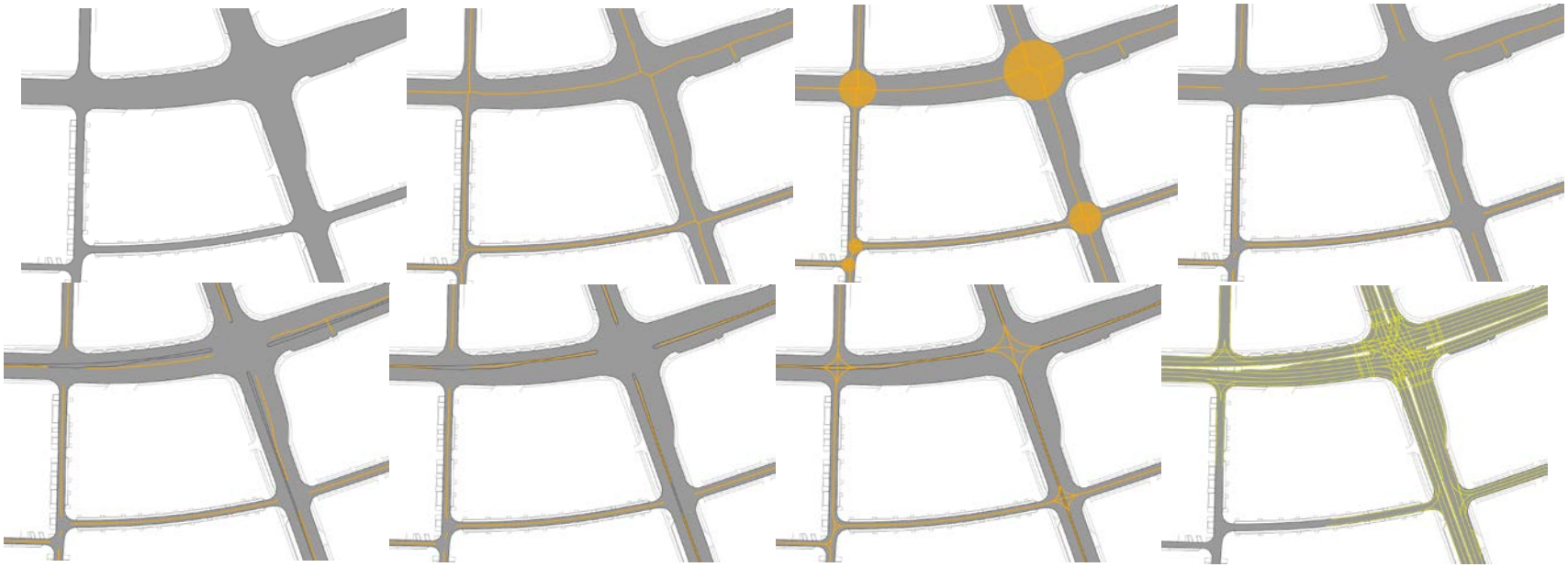




Generation of Road Networks

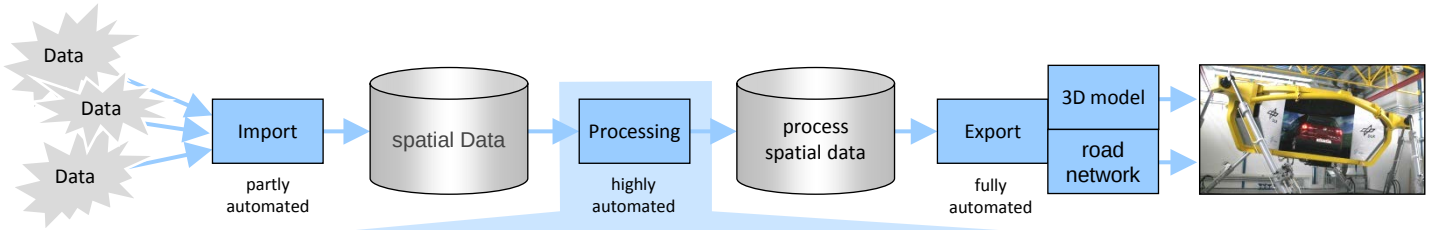
Generation based on Cadastral Data

- steps to generate an OpenDRIVE description from cadastrial data



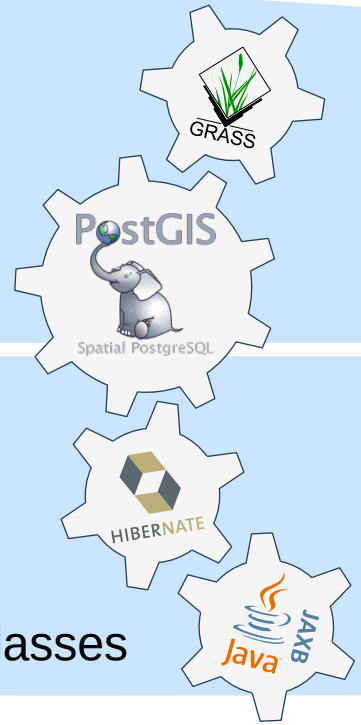
Generation of Road Networks

Generation based on Cadastral Data



- GIS preprocessing
  - cleaning of topology and topography information
  - spatial fusion
  - generation of road surface
  - attribute filtering

- OpenDRIVE generation
  - calculation of road axis including height profile
  - approximate lanes and their connection
  - attaching objects and attributes
  - transformation of persistent geo objects into XML classes



Include road Infrastructure

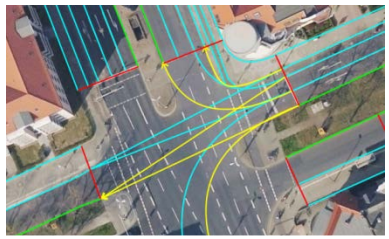
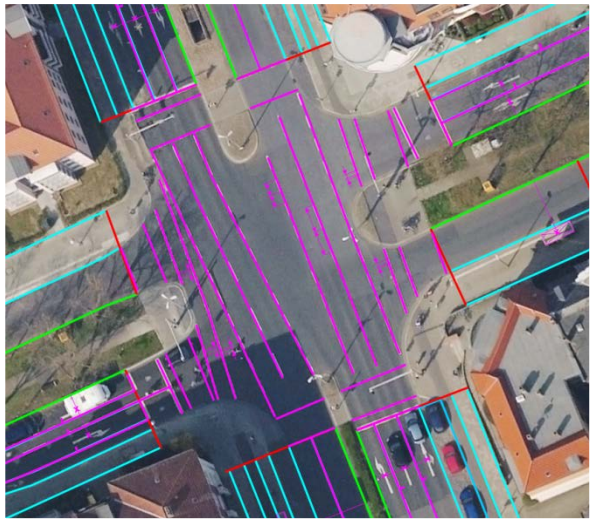
Location and Orientation

- fusion of different cadaster:
  - road signs
  - road signpost
  - traffic lights
  - street lighting
  - catenary
  - ...

Generation of Road Networks
Guided Surveying of the Original

- preparing a guideline to support the preprocessing of surveyed data for easy transformation into OpenDRIVE

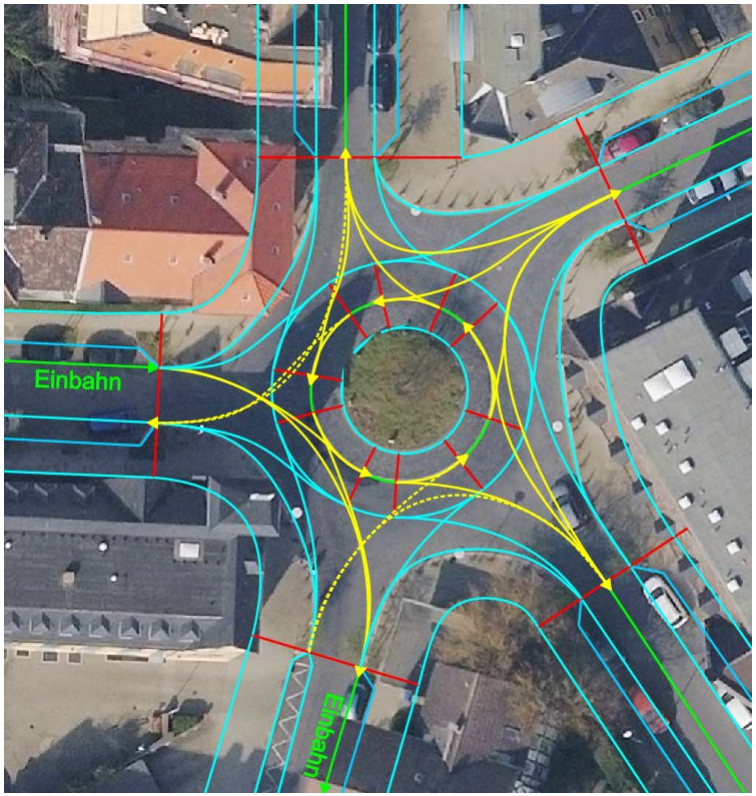


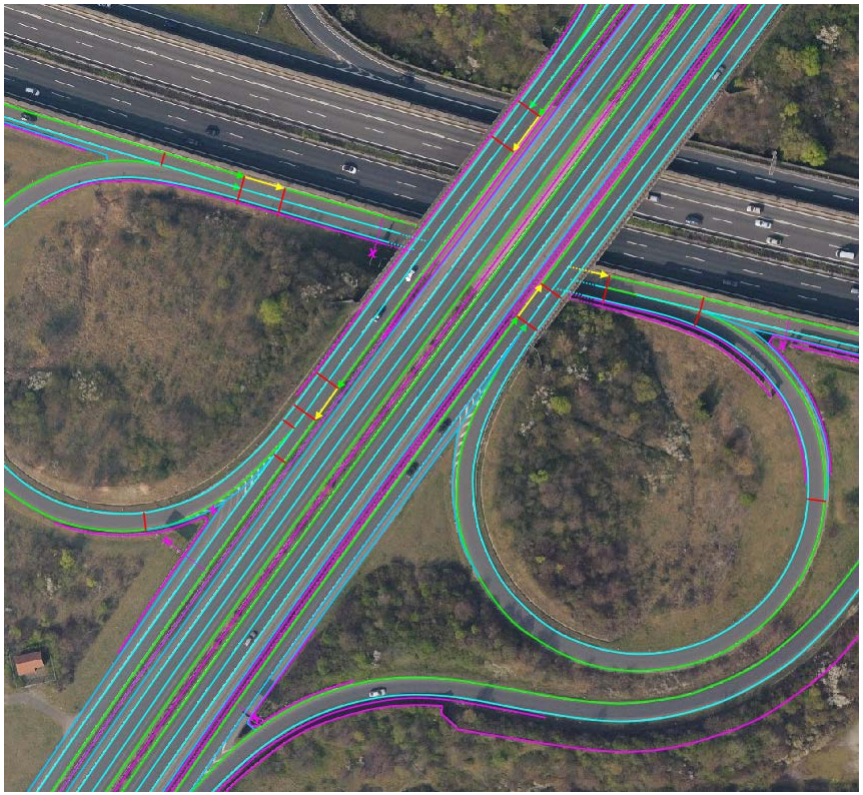




- taking into account road axis, paths, lane edges, markings, objects, signals, traffic lights, etc.

Generation of Road Networks
Guided Surveying of the Original

- definition for all common road scenarios





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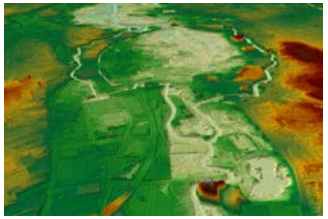
Entire 3D Model

Generation of the entire City
Data Fusion

- processed digital elevation model, textured based on land register data
- combination of vegetation cadaster and airborne laser scanning raw data
- processed street lightning, road sign and traffic light cadaster (locations of poles, orientation, individual components)
- fusion of street furniture data
- integration road network model
- integration city model



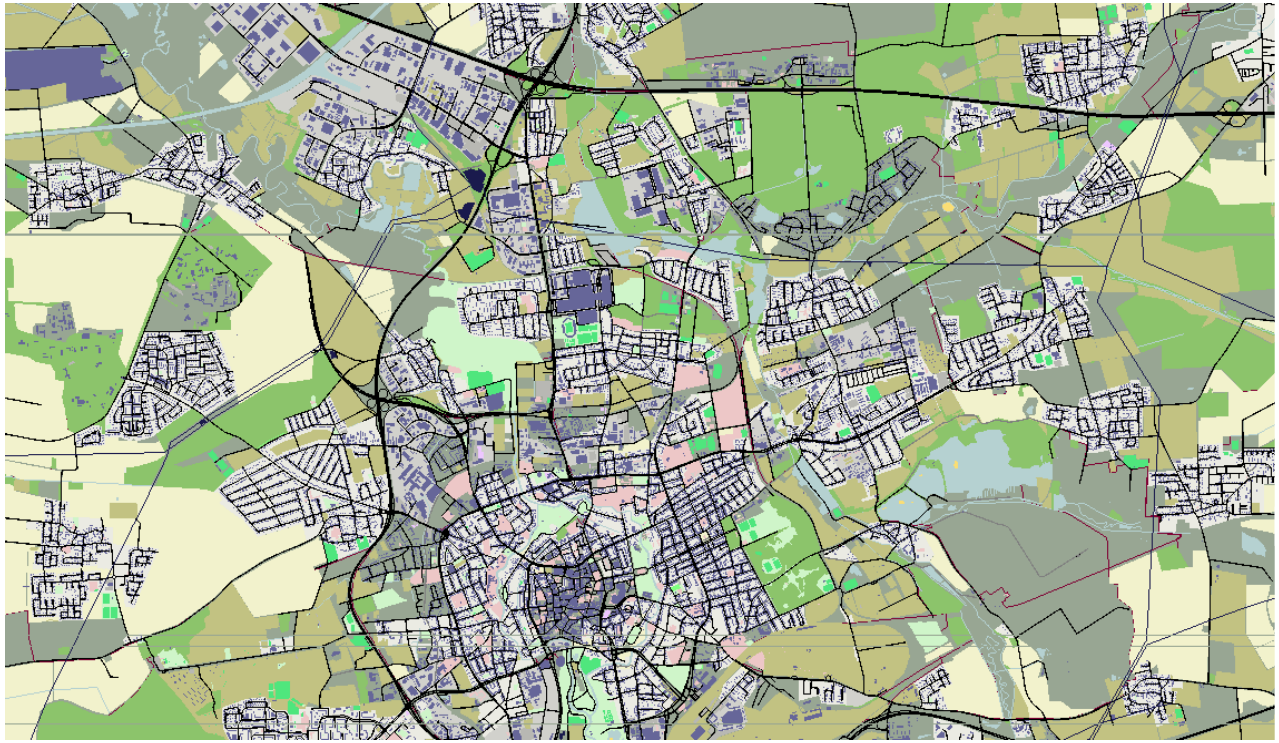
Result
Generated and Paged Data Base for Driving Simulators

- precise modeled 3D world without the need of any manual work

Result
Closer Look

Result
Generated Road Network for…

- usage of the road network in driving an traffic simulators as well as for autonomous driving



To generate new roads where no man has...

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